Alternative approaches to fire simulations in OpenFOAM

Jozsef Nagy
eulerian-solutions e.U.

Fire simulations are used extensively in the building engineering field for the description of heat, smoke, soot distribution in order to estimate the behavior of different fire types in the planning stage of buildings.
Commercial and open-source codes have been available for the description of fires. These codes have advantages as well as disadvantages. OpenFOAM has been emerging as an open-source alternative to other software packages due to its high scalability on high-performance clusters. With this large buildings (e.g. car parks, office buildings, storage areas, etc…) can be analyzed in reasonable times.
For such simulation available models have to be tested especially for cases, where the volume of the fire is very small compared to the volume of the investigated region (e.g. car vs. car park). Validated models have to perform well and negligible effects have to be identified in order to guarantee industrially acceptable simulation runtime while maintaining the quality of the simulation results.
For this reason the well known Steckler Room [1] is being analyzed in this work. Different approaches including combustion (infinite, EDC, EDM, PaSR), turbulence modeling (kEpsilon, kOmega etc...) and also a simplified model with volumetric heat release are being investigated. The influence of the wall as a heat sink is analyzed to further improve the simulation results.
The goal is to find the optimal modeling approach, which can describe the problem settings (see figure 1 below) in a reasonable time frame for engineering purposes.

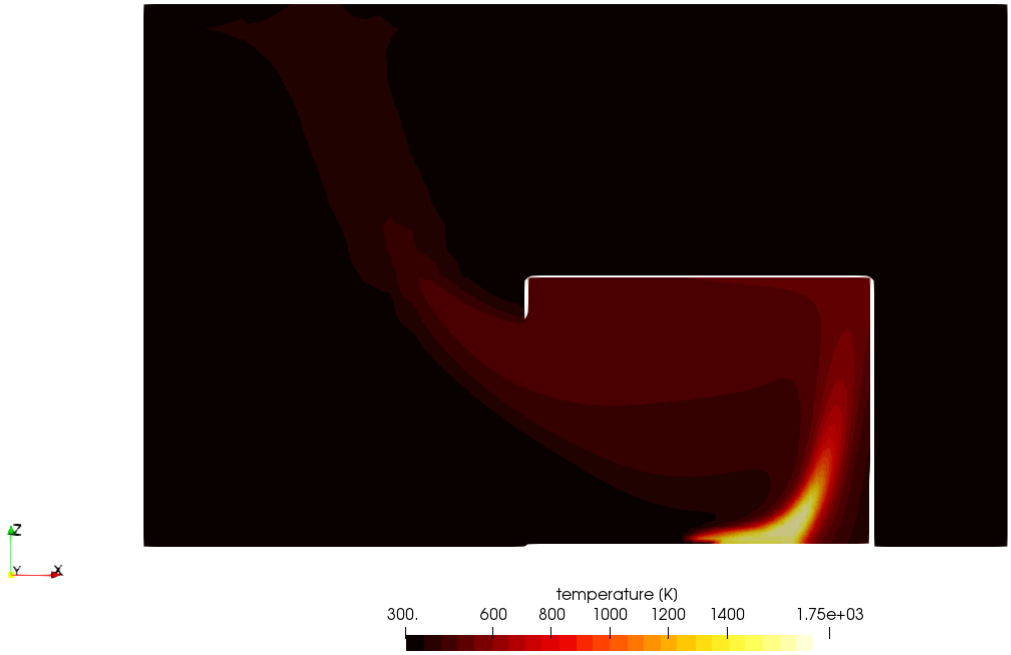

Figure 1: Typical temperature distribution in a fire simulation in the Steckler room

Literature:
[1] K. D. Steckler, J. G. Quintiere and W.J. Rinkinen, Flow induced by fire in a compartment, US Department of Commerce, September 1982